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MONTHLY MICROCLIMATIC SUMMARY

JANUARY 1967

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

USATECOM Project No. 9-4-0013-01

US ARMY
TROPIC TEST CENTER
Fort Clayton, Canal Zone

Sponsored by

Advanced Research Projects Agency, ARPA Order No. 740

Army Research Office, OCRD, Project No. 2M025001A724 01

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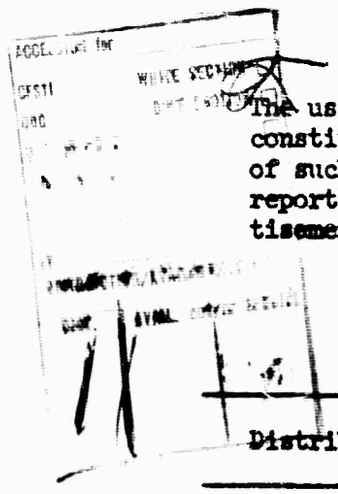

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ENVIRONMENTAL DATA BASE FOR REGIONAL STUDIES IN THE HUMID TROPICS

MONTHLY MICROCLIMATIC SUMMARY

JANUARY 1967

Prepared by

Michael A. Fradel, Project Officer
and
Dr. Wilfried H. Portig, Meteorologist

USATECOM Project No. 9-4-0013-01

This research was supported by the Advanced Research Projects Agency of the Department of Defense and by the Army Research Office, OCRD, Department of Army

Conducted by

US Army
Tropic Test Center
Fort Clayton, Canal Zone
with contractual services provided by
Weather Engineers of Panama Corp.

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MONTHLY MICROCLIMATIC SUMMARY

Introduction

Monthly microclimatic data summarized in this series of reports were collected by the US Army Tropic Test Center and the Weather Engineers of Panama Corporation under the project, Environmental Data Base for Regional Studies in the Humid Tropics. The project is sponsored by the Advanced Research Projects Agency of the Department of Defense and by the Army Research Office, Office of the Chief of Research and Development. It is an investigation of microclimatic, air chemistry, vegetation, soils, microbiological, and macrofaunal conditions at selected sites in the principal tropical environments of the Panama Canal Zone and the Rio Hato Military Reservation. The objective of the project is to assemble quantitative environmental data for RDT&E purposes.

Sites. Data summarized in this report were collected at the Albrook Forest and Chiva Chiva sites. Figure 1 shows the site locations within the Isthmus of Panama. Geographic coordinates are shown below:

Albrook Forest	09° 01'N, 79° 33'W
Chiva Chiva	09° 01'N, 79° 35'W

The Chiva Chiva open site and the Albrook Forest site are paired for comparative study of environmental conditions in a tropical semideciduous forest and in a large clearing. Both are located in a region where the annual precipitation is approximately 80 inches and there is a pronounced dry season. The other satellite sites were located primarily for soil studies purposes. Albrook and Fort Kobbe have climatic regimes similar to the principal sites.

The Albrook and Chiva Chiva main sites are approximately four kilometers apart. Each has a 46 meter walk-up tower and an air-conditioned building to house the recording equipment and observers. Both sites are approximately 30 meters above sea level. The top of the forest canopy at the Albrook site is about 26.5 meters above the ground.

Instrumentation. A wide range of climatic elements are measured at the Albrook and Chiva Chiva sites. Types of observations and frequencies are shown on Figure 2. The towers at the Albrook and Chiva Chiva sites are similarly oriented. Sensing equipment is mounted at several levels on the towers to provide measurements through the vertical profile. Additional instruments are emplaced in the immediate vicinity on or near the ground. All instrument exposures are duplicated at each site. Figures 3, 4, and 5 show the instrument array at these sites.

Data Reduction and Storage. All data, as applicable, are recorded at or reduced to each full hour and transposed to punch cards. These punch cards, together with all raw data, are stored in the Tropic Test Center Technical Library Annex.

The relative humidity data contained in this report required some adjustment due to the difficult problems in maintaining hair hygrometers in the humid tropics. The hygrometers show saturation at a time when the psychrometer shows a relative humidity well below 100%. For this reason the hourly measurements made by means of a hair hygrometer have been modified on the basis of simultaneous psychrometer readings of other levels. Details will be given in the fourth Semiannual Report. It can be assumed that the means of relative humidity presented in this volume are very close to the true means.

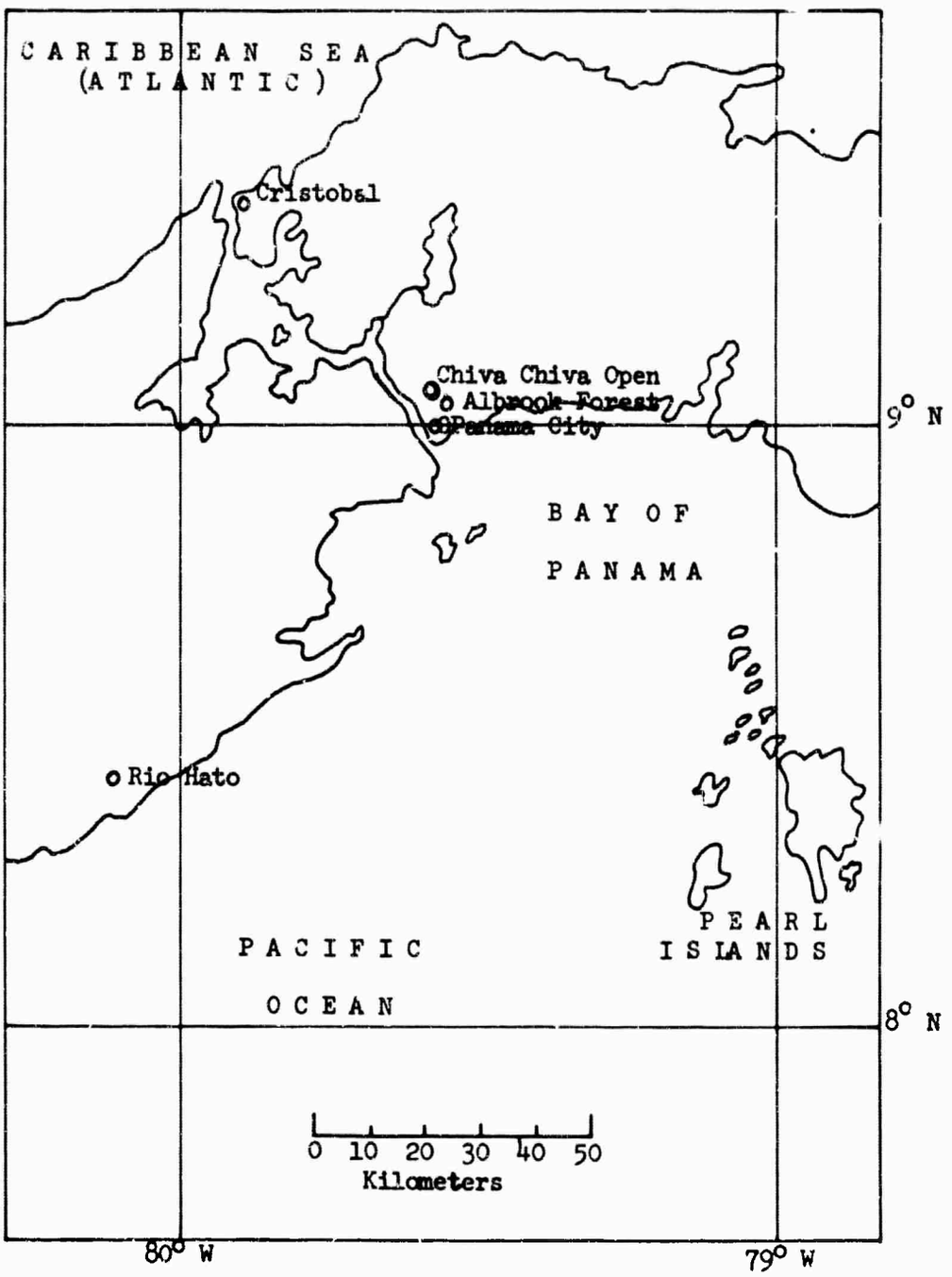

FIGURE 1. LOCATION MAP, ISTHMUS OF PANAMA

FIGURE 2. FREQUENCY OF OBSERVATIONS

# Element	Height (meters) Sfc	0.5	1.0	2.0	4.0	8.0	13.5	26.5	28.5	46.0	Frequency
Temperature:											
Dry Bulb	-	1	1	1	1	2	1	1	-	1	Hourly*/Continuously
Wet Bulb	-	1	-	1	1	-	-		-	-	Hourly*/Continuously
Grass Minimum	3	-	-	-	-	-	-	-	-	-	Once Daily
WBGT Index	-	-	1	-		-	-	-	-	-	Hourly (0600-1900 EST)
Relative Humidity	-	1	1	1	1	-	1	1	-	1	Hourly*/Continuously
Barometric Pressure	-	-	1	-	-	-	-	-	-	-	Continuously
Evaporation	-	1	-	-	-	-	2	2	-	2	Once Daily
Precipitation:											
Recording Gage	-	-	1	-	-	-	-	-	-	2	Continuously
Manual Gage	-	-	2	-	-	-	-	-	-	-	4 Times Daily
Stem Flow	-	-	-	2	-	-	-	-	-	-	4 Times Daily
Wind:											
Direction	-	-	-	-	1	-	-	1	-	1	Continuously
Speed	-	-	-	3**	1	-	3**	1	-	1	Hourly**/Continuously

1. Albrook and Chiva Chiva
2. Albrook only
3. Chiva Chiva only

* Observations made with sling psychrometer when recorders are inoperative.

** Hourly

\# Instrument descriptions are contained in the Environmental Data Base semiannual reports.

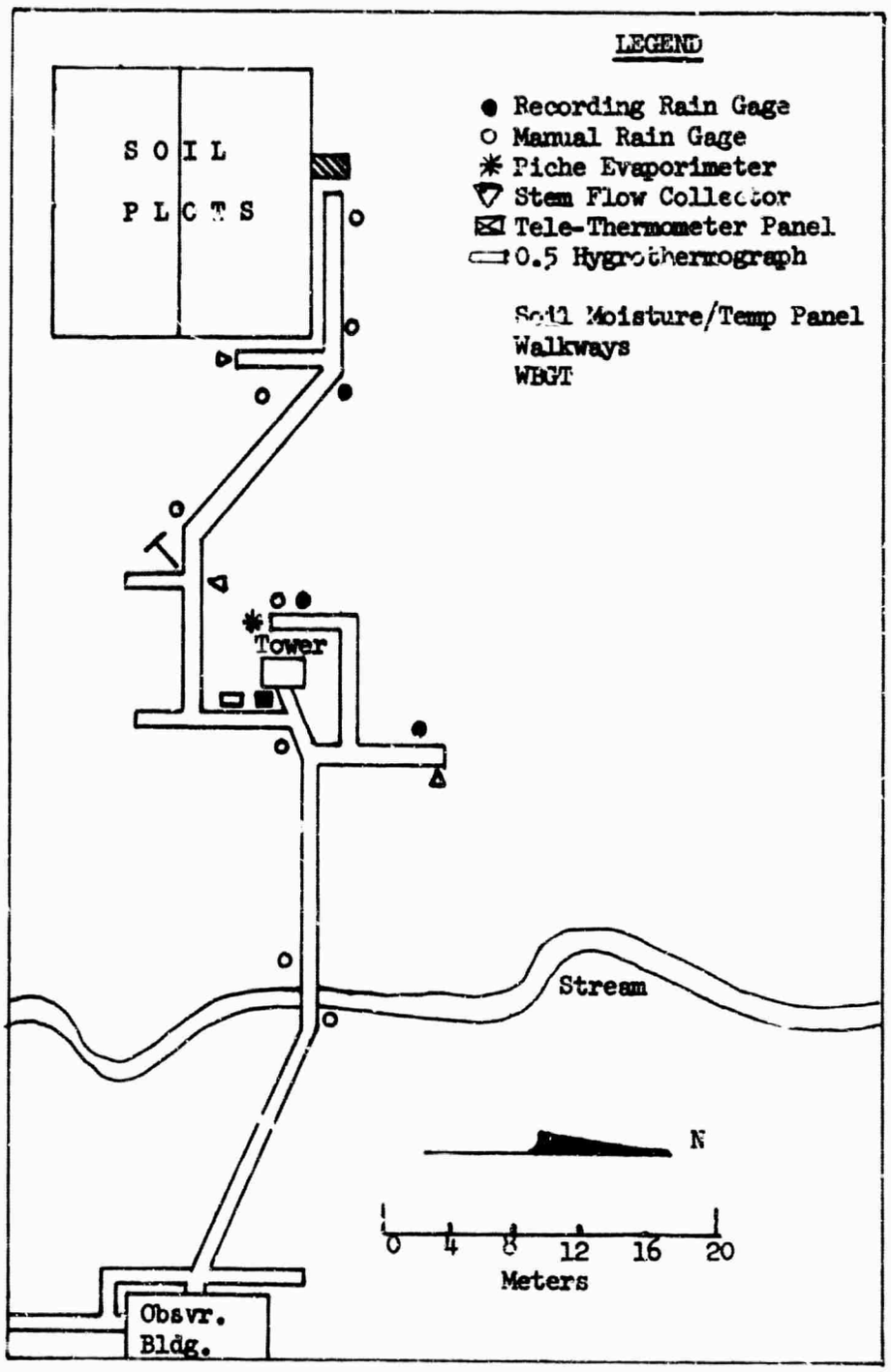

FIGURE 3. ALBROOK FOREST SITE, GENERALIZED PLOT

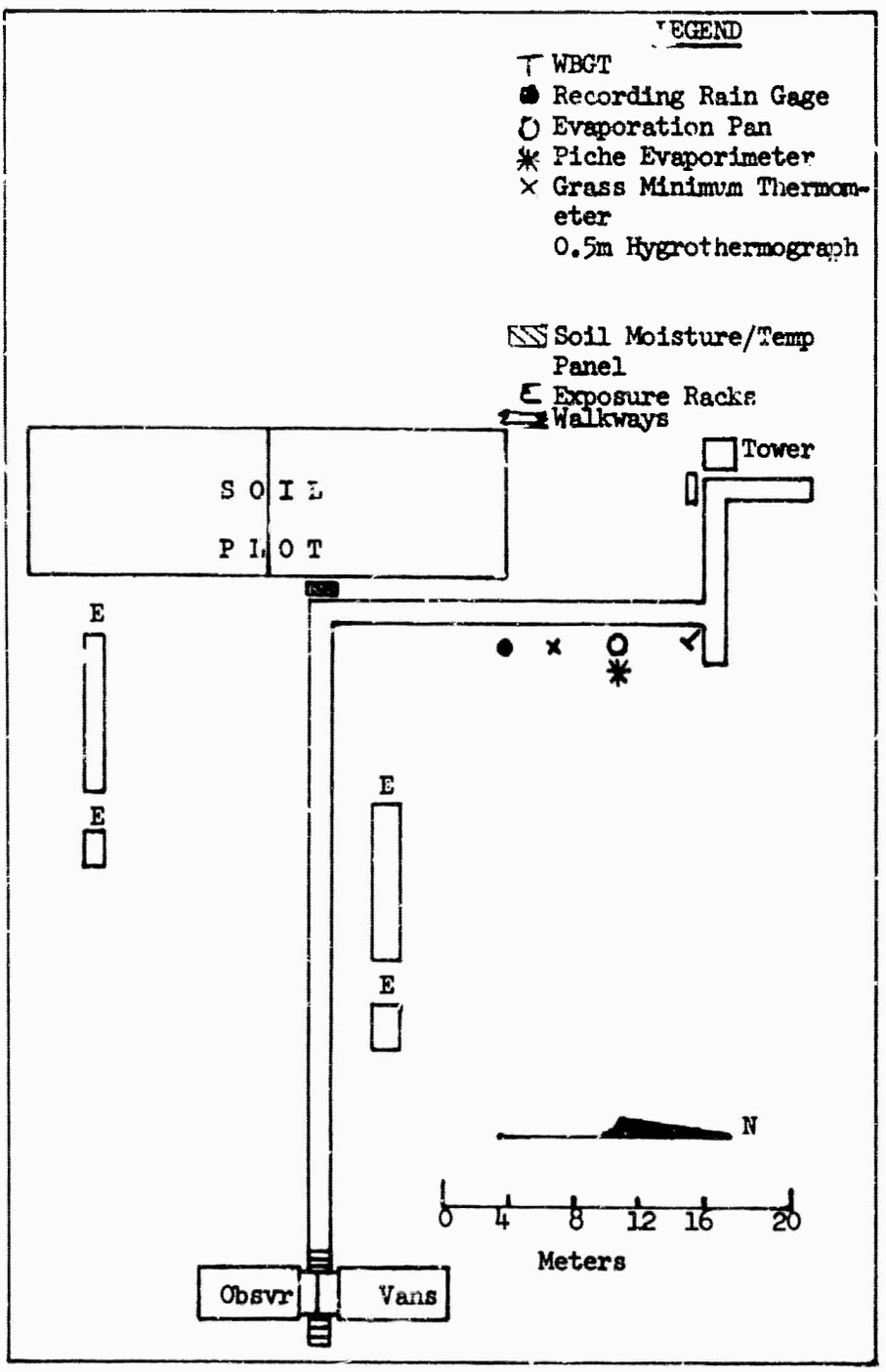

FIGURE 4. CHIVA CHIVA OPEN, GENERALIZED PLOT

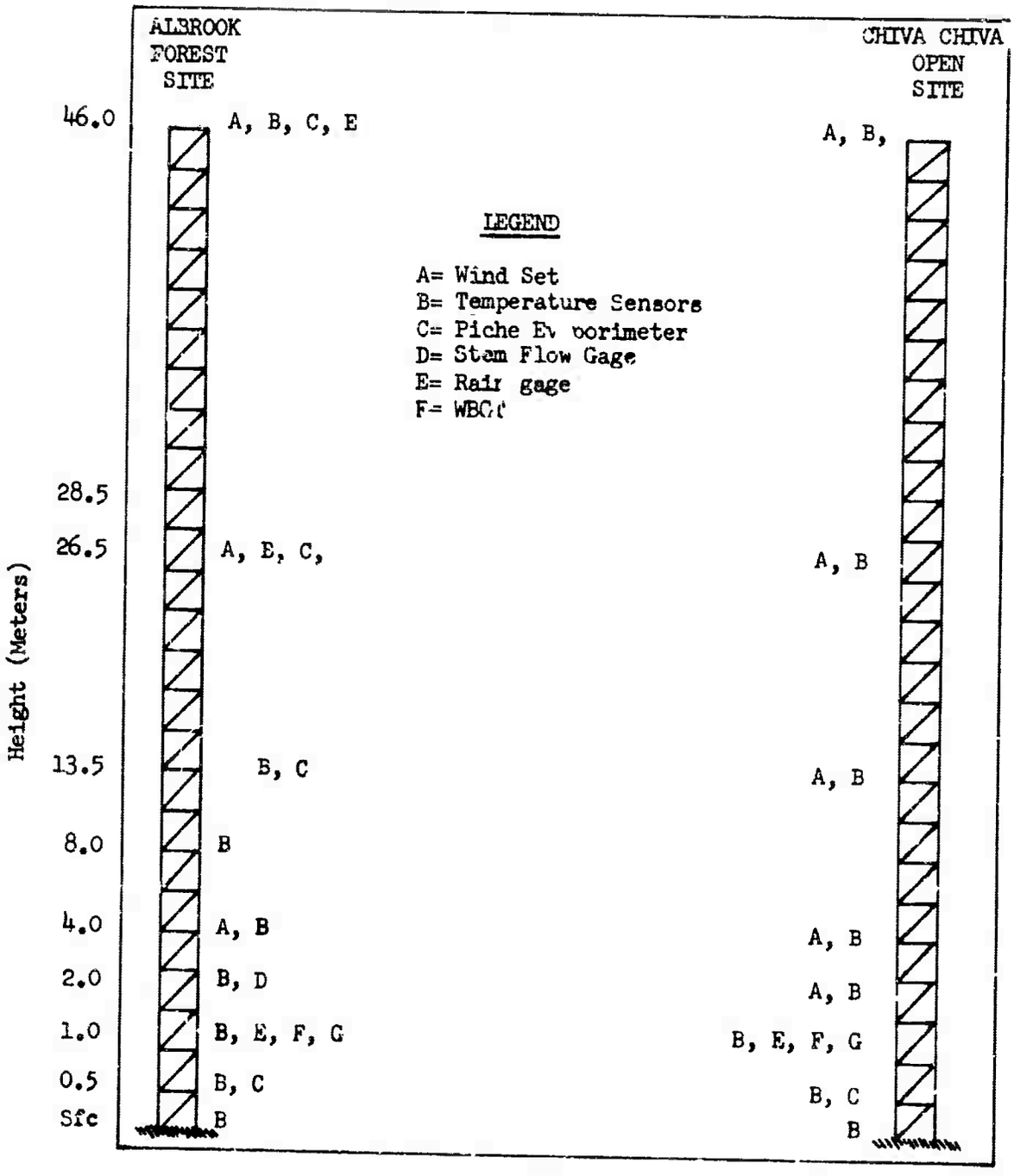

FIGURE 5. INSTRUMENT LOCATION ON TOWERS

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Means of Air Temperature by Hour (°F)																							Monthly Summary			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of obs.	Min.	Mean	Max.
Albrook (Forest site)	46.0 m	74.9	74.7	74.5	74.4	74.2	74.2	74.7	76.8	80.6	82.7	84.0	84.9	85.6	85.3	85.0	83.7	82.3	90.1	77.8	76.7	76.0	75.5	75.0	74.9	744	71.7	78.7	89.2
	28.5 m	This level was not instrumented for air temperature at this time																											
	26.5 m	74.5	74.3	74.0	73.9	73.6	73.5	73.8	76.3	80.8	83.3	84.8	85.6	86.1	86.2	86.0	84.7	83.6	81.0	77.9	76.6	75.7	75.3	74.9	74.6	744	69.1	78.8	89.1
	13.5 m	74.1	73.9	73.6	73.4	73.3	73.0	72.9	74.9	78.5	81.2	83.2	84.5	85.0	85.3	84.6	83.5	82.5	80.1	77.8	76.5	75.6	74.9	74.5	74.2	744	69.3	78.0	88.2
	8.0 m	73.5	73.2	73.1	72.6	72.6	72.5	72.4	74.8	78.6	81.2	82.9	83.9	84.6	84.5	83.8	82.9	81.5	78.9	76.5	75.5	74.7	74.3	73.8	73.5	743	69.1	77.3	87.9
	4.0 m	73.1	72.8	72.5	72.2	72.3	72.0	72.1	74.7	78.6	81.1	82.7	83.6	84.6	84.3	84.0	82.8	81.0	78.1	76.2	75.0	74.2	73.9	73.4	73.1	744	69.0	77.0	87.8
	2.0 m	73.0	72.7	72.4	72.2	72.2	72.0	72.0	74.5	78.2	80.5	82.3	83.3	84.3	84.1	84.0	82.7	80.8	78.1	76.2	74.9	74.1	73.3	73.3	73.1	744	69.0	76.9	87.7
	1.0 m	73.2	73.0	72.8	72.5	72.4	72.1	72.2	74.5	78.2	80.7	82.4	83.6	84.5	84.9	83.9	82.8	81.1	78.4	76.2	75.5	74.7	74.1	73.8	73.4	744	69.2	77.1	91.0
	0.5 m	73.5	73.2	73.0	72.7	72.6	72.4	72.3	74.0	77.3	79.7	81.6	83.0	83.7	83.8	83.8	82.8	81.3	79.0	76.9	75.7	74.9	74.3	73.9	73.5	742	70.0	77.0	86.7

Exposure		Monthly Means of Air Temperature by Hour (°F)																							Monthly Summary			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of obs.	Min.	Mean	Max.
Chiva Chiva (Open site)	46.0 m	75.1	75.0	74.9	74.8	74.7	74.6	74.9	76.2	79.3	81.4	83.0	84.0	84.5	84.5	84.2	83.3	82.1	80.2	77.9	76.9	76.2	75.9	75.5	75.3	743	72.3	78.5	86.7
	28.5 m	This level was not instrumented for air temperature at this time																											
	26.5 m	75.1	74.9	74.8	74.7	74.5	74.3	74.4	76.5	79.6	81.8	83.4	84.5	84.9	85.0	84.6	83.9	82.7	80.6	78.3	77.3	76.4	76.0	75.6	75.4	744	71.4	78.7	86.5
	13.5 m	74.9	74.7	74.6	74.5	74.3	74.1	74.2	76.4	80.1	82.2	83.7	84.7	85.2	85.3	84.9	84.0	82.7	80.6	78.2	77.1	76.3	75.9	75.5	75.2	744	70.2	78.7	87.6
	8.0 m	This level was not instrumented for air temperature at this time																											
	4.0 m	74.3	74.0	74.1	74.0	73.7	73.2	73.9	78.4	81.3	84.1	85.2	86.3	86.7	86.6	85.9	84.7	82.9	79.7	77.3	76.2	75.4	75.0	74.8	74.6	744	69.5	78.8	89.5
	2.0 m	73.8	73.6	73.7	73.7	73.2	72.5	73.6	78.8	82.0	84.8	86.3	87.5	87.8	87.7	86.7	85.4	83.6	79.7	77.2	76.0	75.2	74.8	74.4	74.1	744	68.8	79.0	90.4
	1.0 m	73.8	73.5	73.5	73.3	73.0	72.3	73.5	79.2	82.7	85.6	87.0	88.6	88.8	88.6	87.4	85.5	83.5	79.6	76.9	76.5	75.5	74.9	74.4	74.1	744	68.5	79.2	93.0
	0.5 m	73.4	73.3	73.1	73.1	72.8	72.4	73.2	80.0	84.6	87.4	88.8	90.3	90.0	90.1	88.5	86.5	84.2	79.5	77.0	75.8	75.0	74.5	74.1	73.7	744	68.9	79.6	94.9

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Ranges of Air Temperature by Hour (°F)																								Monthly Summary*			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Albrook (forest site)	46.0 m	3.8	3.3	3.0	3.7	5.0	5.4	3.6	5.9	6.9	4.9	4.9	6.5	7.6	7.1	8.1	10.0	8.4	7.4	6.2	2.9	3.6	3.3	4.6	4.8				
	28.5 m	This level was not instrumented for air temperature at this time																											
	26.5 m	3.7	3.9	5.1	7.0	7.5	8.0	6.3	7.4	6.9	5.5	5.4	7.1	8.1	7.5	8.6	10.9	10.8	10.0	6.2	4.2	3.8	3.0	4.2	4.3				
	13.5 m	5.6	5.9	6.4	5.8	6.4	6.9	5.6	6.3	5.0	5.2	6.2	8.8	7.8	7.2	8.6	9.0	8.3	7.9	5.1	4.5	4.3	4.8	4.9	4.7				
	8.0 m	4.9	5.6	5.6	5.6	5.4	5.6	6.1	5.5	5.3	6.6	7.4	10.8	7.0	7.9	9.1	8.9	8.3	10.2	5.1	4.9	5.1	4.9	5.2	4.7				
	4.0 m	5.7	5.0	5.1	5.8	5.3	5.4	5.1	6.1	5.5	5.5	6.7	9.3	7.8	7.5	7.9	8.6	6.8	6.5	4.9	4.5	5.1	5.5	5.6	5.5				
	2.0 m	5.9	5.5	5.0	5.2	5.8	5.5	5.4	5.8	5.2	5.5	7.0	9.7	8.3	7.2	7.5	8.7	6.6	5.7	5.0	4.5	5.0	5.2	5.3	5.7				
	1.0 m	4.7	4.1	4.1	4.5	4.8	4.3	4.9	5.0	5.0	6.1	7.5	9.4	9.5	10.2	9.3	9.0	6.5	6.2	4.2	4.3	4.5	4.9	5.1	4.9				
	0.5 m	6.2	5.2	5.0	4.2	4.2	5.0	5.3	5.4	3.8	4.0	7.4	7.0	7.2	6.6	6.6	7.8	7.2	5.8	4.8	3.7	3.8	4.8	5.4	5.6				

* No monthly summary was computed for the ranges.

Chiva Chiva (Open site)	46.0 m	2.6	3.4	3.7	3.8	4.1	3.6	3.3	3.8	5.1	3.7	3.8	4.4	6.0	4.9	8.3	7.7	7.4	6.8	4.7	3.3	3.3	3.8	3.8	3.7				
	28.5 m	This level was not instrumented for air temperature at this time																											
	26.5 m	3.9	3.4	3.6	5.1	5.1	5.0	4.7	5.8	4.9	4.6	3.8	4.9	5.9	5.0	8.1	8.2	8.3	8.1	5.1	3.9	3.4	3.9	4.3	4.1				
	13.5 m	3.5	4.0	5.0	5.4	6.7	6.3	6.4	5.4	4.6	4.0	4.2	4.5	6.6	5.9	8.1	7.6	7.2	6.6	6.2	4.0	3.4	3.2	3.5	3.4				
	8.0 m	This level was not instrumented for air temperature at this time																											
	4.0 m	5.7	5.7	6.6	6.6	6.5	5.8	5.9	6.6	7.6	5.9	5.3	7.0	7.8	8.1	10.9	10.7	9.1	6.5	4.2	4.5	4.7	4.3	4.9	6.2				
	2.0 m	5.6	5.7	6.3	6.2	7.6	7.4	6.0	7.2	7.8	6.0	6.3	7.5	8.1	8.0	11.1	9.1	9.1	6.3	4.4	4.4	5.6	4.9	5.8	5.6				
	1.0 m	4.8	4.8	5.5	5.7	6.5	7.5	6.5	8.7	10.6	9.2	8.3	10.0	9.0	10.0	13.2	10.3	8.9	6.2	6.4	3.8	4.6	4.0	4.6	4.8				
	0.5 m	6.0	6.4	6.7	6.1	7.1	7.3	6.2	7.5	10.8	9.7	10.8	13.9	15.4	10.6	10.1	10.5	9.0	6.4	4.0	3.6	5.1	4.6	4.8	5.6				

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Means of Relative Humidity by Hour (%)																								Monthly Summary			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of obs.	Min.	Mean	Max.
Albrook (Forest site)	46.0 m	85	86	8	86	86	86	85	80	72	67	62	60	58	59	61	63	67	72	77	81	83	84	85	85	740	46	76	96
	28.5 m	This level was not instrumented for relative humidity at this time																											
	26.5 m	88	89	89	89	90	90	88	83	72	67	63	60	58	60	61	63	66	73	79	82	85	86	87	88	744	50	77	97
	13.5 m	92	92	93	93	93	94	94	92	81	74	69	65	63	63	66	67	69	74	79	84	87	90	91	91	744	51	61	97
	8.0 m	This level was not instrumented for relative humidity at this time																											
	4.0 m	94	95	96	96	96	96	96	93	83	75	71	67	64	66	69	70	74	80	84	88	91	91	93	94	744	50	84	100
	2.0 m	95	95	96	96	96	96	97	94	86	78	73	70	66	67	69	72	76	81	85	89	91	92	94	94	744	52	85	100
	1.0 m	94	94	94	95	95	95	96	95	87	79	74	70	68	68	70	72	77	81	86	88	91	92	92	93	744	57	85	98
	0.5 m	94	94	94	95	95	95	96	95	91	84	78	74	71	71	72	75	79	82	86	88	90	92	93	93	730	56	87	100

Chiva Chiva (Open site)	46.0 m	86	87	87	88	87	88	87	83	76	70	64	61	59	59	60	63	66	72	77	81	84	85	85	86	744	43	77	98
	28.5 m	This level was not instrumented for relative humidity at this time																											
	26.5 m	87	88	88	88	88	89	88	83	74	68	63	60	59	58	59	62	65	71	77	82	84	85	86	87	744	47	77	97
	13.5 m	88	88	87	88	88	89	88	82	74	68	62	59	58	58	59	62	66	72	78	82	84	85	86	87	744	47	77	98
	8.0 m	This level was not instrumented for relative humidity at this time																											
	4.0 m	90	91	90	91	91	92	92	82	74	67	62	59	59	59	60	63	68	73	80	83	86	88	89	89	744	48	78	100
	2.0 m	91	91	90	91	91	93	92	81	72	65	62	58	58	57	59	62	66	73	80	84	86	86	89	90	743	46	78	99
	1.0 m	91	91	91	91	92	93	92	83	74	66	60	57	56	56	57	60	65	74	82	85	87	88	89	90	742	46	78	99
	0.5 m	92	92	92	92	93	94	93	79	69	62	59	56	56	55	58	62	65	75	81	84	87	89	90	90	714	42	78	100

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Ranges of Relative Humidity by Hour (%)																								Monthly Summary*			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Albrook (Forest site)	46.0 m	12	9	10	13	7[illegible]	20	15	18	27	27	29	32	34	30	35	35	34	26	20	17	9	11	12	13				
	28.5 m	This level was not instrumented for relative humidity at this time																											
	26.5 m	12	13	9	14	17	16	13	18	30	22	22	28	32	31	31	40	31	25	26	16	11	12	11	12				
	13.5 m	9	12	10	8	11	11	[illegible]	11	24	25	30	38	35	32	42	38	40	28	25	20	15	10	9	9				
	8.0 m	This level was not instrumented for relative humidity at this time																											
	4.0 m	12	13	10	9	8	9	11	13	24	28	37	47	39	40	41	44	37	26	24	19	15	13	14	12				
	2.0 m	10	12	9	8	8	9	10	11	23	29	35	46	39	37	39	43	32	29	22	19	14	13	13	9				
	1.0 m	7	9	8	8	6	6	6	9	22	30	31	36	32	29	37	37	27	22	16	12	10	8	7	8				
	0.5 m	13	11	11	10	10	6	8	8	17	25	33	38	36	36	37	38	34	26	21	18	12	15	12	12				

* No monthly summary was computed for the ranges.

Chiva Chiva (Open site)	46.0 m	16	16	12	16	14	20	20	12	18	17	16	27	29	29	33	35	31	27	20	14	14	16	16	18				
	28.5 m	This level was not instrumented for relative humidity at this time																											
	26.5 m	17	16	10	14	14	18	14	13	19	18	20	26	32	30	34	35	32	26	22	15	15	18	17	18				
	13.5 m	16	13	13	17	14	17	16	14	19	17	20	27	32	31	34	35	32	25	20	16	16	18	19	20				
	8.0 m	This level was not instrumented for relative humidity at this time																											
	4.0 m	18	15	13	16	17	15	17	20	28	18	19	29	33	31	32	34	35	27	23	19	18	14	16	19				
	2.0 m	16	11	12	13	14	12	13	23	29	23	21	27	34	33	33	34	37	25	25	20	19	20	19	20				
	1.0 m	13	11	13	14	14	12	13	23	28	22	22	32	38	33	34	36	33	26	17	13	11	14	18	16				
	0.5 m	11	12	13	11	13	14	12	23	33	22	25	40	43	31	27	40	33	24	22	16	12	14	18	19				

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Means[2] of other Elements by Hour																							Monthly Summary			
Site	Code[1]	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of obs.	Min.	Mean	Max.
Albrook (forest site)	WB (4.0 m)	71.9	71.8	71.6	71.5	71.5	71.3	71.4	73.3	74.8	75.0	75.3	75.0	74.9	75.2	75.6	75.1	74.6	73.5	72.8	72.4	72.3	72.1	72.0	71.9	744	68.0	73.2	80.0
	WB (2.0 m)	72.0	71.7	71.6	71.5	71.5	71.3	71.4	73.3	75.0	75.4	75.5	75.4	75.3	75.4	75.9	75.5	75.0	73.9	73.0	72.5	72.3	72.2	72.1	71.9	744	68.0	73.4	79.5
	WB (0.5 m)	72.2	72.0	71.8	71.7	71.6	71.5	71.4	73.0	75.2	75.9	76.2	76.3	76.2	76.2	76.4	76.2	75.8	74.9	73.7	73.1	72.7	72.5	72.3	72.1	730	68.8	73.8	80.6
	BP	.728	.714	.700	.695	.700	.711	.733	.755	.770	.773	.762	.739	.712	.688	.666	.662	.667	.678	.700	.715	.735	.746	.747	.743	744	.620	.718	.820
	P1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.03	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5	0.01	0.51	0.38
	P2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.26	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	0.01	0.33	0.26
	P3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.30	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	0.01	0.37	0.30
	P4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.31	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	0.01	0.41	0.33
Chiva Chiva (Open site)	WB (4.0 m)	72.2	72.0	72.0	72.0	71.7	71.5	72.1	74.2	74.8	75.1	75.1	75.0	75.2	75.1	75.0	74.7	74.5	73.3	72.8	72.6	72.5	72.4	72.4	72.3	744	69.2	73.4	79.9
	WB (2.0 m)	71.9	71.7	71.7	71.8	71.5	71.1	71.9	74.4	75.1	75.5	75.7	75.6	75.6	75.5	75.3	75.0	74.5	73.3	72.7	72.5	72.3	72.2	72.0	71.9	743	68.2	73.4	78.5
	WB (0.5 m)	71.7	71.6	71.6	71.5	71.3	71.1	71.8	74.9	76.3	76.8	77.0	77.2	76.9	76.8	76.4	75.8	75.1	73.5	72.7	72.5	72.3	72.2	72.0	71.8	744	68.7	73.8	79.3
	BP	.813	.799	.785	.782	.786	.800	.818	.841	.860	.863	.854	.831	.806	.777	.756	.753	.757	.768	.788	.804	.825	.835	.834	.829	744	.705	.807	.915
	PS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2	0.02	0.11	0.09

WB - Wet bulb temperature (°F)
BP - Barometric pressure (in of Hg minus 29.0)

PS - Precipitation at 1.0 m. in open area (in.)
P1 - Precipitation at 46.0 m. above canopy (in.)
P2 - Precipitation under full canopy (in.)
P3 - Precipitation under drip canopy (in.)
P4 - Precipitation under open canopy (in.)

[2] Monthly means of precipitation are computed for precipitation days. Precipitation totals are substituted for the mean in the monthly summary.

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Ranges[2] of other Elements by Hour																						Monthly Summary*			
Site	Code[1]	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Albrook (Forest site)	WB (4.0 m)	4.5	4.3	4.0	4.0	5.0	5.5	4.9	3.3	4.0	3.8	4.9	5.8	5.7	6.2	7.2	8.2	7.1	5.7	4.9	4.2	3.8	4.0	4.7	4.5				
	WB (2.0 m)	4.1	4.5	4.3	4.5	5.0	5.5	5.1	3.5	3.3	4.0	5.3	6.0	5.2	5.7	6.1	7.8	6.0	5.1	4.5	4.2	4.1	4.1	4.4	4.2				
	WB (0.5 m)	4.4	4.5	4.9	5.1	5.3	5.5	5.8	4.9	3.0	3.7	4.9	8.2	5.4	5.7	6.2	6.2	6.0	6.0	4.8	4.5	4.3	4.2	3.8	4.4				
	BP	.090	.095	.095	.100	.110	.105	.110	.100	.095	.090	.115	.105	.105	.120	.085	.090	.100	.115	.115	.110	.120	.115	.110	.095				
	P1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
	P2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
	P3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
	P4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Chiva Chiva (Open site)	WB (4.0 m)	3.7	3.7	4.0	3.0	4.2	3.7	4.4	3.1	2.8	4.2	4.2	5.1	5.2	5.9	8.0	7.4	8.2	5.2	5.0	5.1	4.2	3.8	4.1	4.4				
	WB (2.0 m)	4.2	3.8	4.0	3.5	5.5	5.0	4.2	2.8	2.7	4.5	4.5	4.5	5.0	6.3	6.0	4.8	6.5	5.5	5.0	5.1	4.5	4.1	4.5	4.5				
	WB (0.5 m)	3.5	3.9	4.4	3.7	4.6	4.6	3.6	3.5	3.0	3.3	3.8	3.4	3.2	3.4	3.0	3.5	4.6	4.0	3.9	3.9	3.5	3.4	4.1	4.3				
	BP	.100	.090	.090	.090	.110	.110	.105	.100	.100	.095	.100	.100	.095	.100	.090	.095	.115	.120	.140	.130	.115	.110	.105	.100				
	PS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				

* No monthly summary was computed for the ranges.

WB - Wet bulb temperature (°F)
BP - Barometric pressure (in. of Hg minus 29.0)

PS - Precipitation at 1.0 m. in open area (in.)
P1 - Precipitation at 46.0 m. above canopy (in.)
P2 - Precipitation under full canopy (in.)
P3 - Precipitation under drip canopy (in.)
P4 - Precipitation under open canopy (in.)

[2] Monthly ranges of precipitation are computed for precipitation days.

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Means of Wind Speed by Hour (miles/hr.)																								Monthly Summary			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of obs.	Min.	Mean	Max.
Albrook (Forest site)	46.0 m	6	5	5	5	5	6	6	5	6	8	10	9	9	10	8	9	7	6	6	6	5	5	6	6	712	0	7	22
	28.5 m	This level was not instrumented for wind speed at this time																											
	26.5 m	1	1	1	1	1	1	2	2	2	3	3	3	3	4	2	3	2	2	2	1	2	2	2	2	710	0	2	17
	13.5 m	This level was not instrumented for wind speed at this time																											
	8.0 m	This level was not instrumented for wind speed at this time																											
	4.0 m	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	1	1	709	0	0	6
	2.0 m	This level was not instrumented for wind speed at this time																											
	1.0 m	This level was not instrumented for wind speed at this time																											
	0.5 m	This level was not instrumented for wind speed at this time																											
Chivá Chiva (Open site)	46.0 m	7	7	8	7	7	7	7	7	9	11	12	13	13	14	13	12	11	10	8	9	8	8	8	7	741	0	9	25
	28.5 m	This level was not instrumented for wind speed at this time																											
	26.5 m	6	6	7	6	5	5	5	6	8	11	11	13	13	14	13	12	11	9	8	7	7	6	6	6	725	0	8	24
	13.5 m	3	3	3	3	2	2	2	4	7	11	13	14	14	14	14	12	10	8	5	5	4	4	4	4	744	0	7	30
	8.0 m	This level was not instrumented for wind speed at this time																											
	4.0 m	3	3	4	4	3	3	3	5	7	9	10	10	10	12	10	10	8	7	5	5	4	4	4	4	722	0	6	19
	2.0 m	1	2	2	2	1	1	1	3	5	7	8	9	9	10	9	8	7	4	3	3	2	2	2	2	744	0	4	16
	1.0 m	This level was not instrumented for wind speed at this time																											
	0.5 m	This level was not instrumented for wind speed at this time																											

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

JANUARY 1967

Exposure		Monthly Ranges of Wind Speed by Hour (miles/hr.)																							Monthly Summary*			
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Albrook (Forest site)	46.0 m	11	12	11	10	13	10	11	11	16	16	19	13	20	22	17	16	11	9	8	10	10	9	11	11				
	28.5 m	This level was not instrumented for wind speed at this time																											
	26.5 m	5	5	5	5	4	5	6	5	11	8	14	10	10	17	5	7	10	9	4	4	5	5	5	7				
	13.5 m	This level was not instrumented for wind speed at this time																											
	8.0 m	This level was not instrumented for wind speed at this time																											
	4.0 m	3	3	3	3	1	3	1	1	2	2	3	4	4	4	3	2	2	4	1	1	2	1	6	4				
	2.0 m	This level was not instrumented for wind speed at this time																											
	1.0 m	This level was not instrumented for wind speed at this time																											
	0.5 m	This level was not instrumented for wind speed at this time																											

* No monthly summary was computed for the ranges.

Chiva Chiva (Open site)	46.0 m	13	11	16	12	12	12	12	10	13	21	15	19	19	15	14	13	11	11	10	9	10	12	14	15				
	28.5 m	This level was not instrumented for wind speed at this time																											
	26.5 m	10	13	16	9	10	11	12	11	13	14	13	22	19	15	14	15	12	12	9	8	14	11	13	14				
	13.5 m	11	24	9	11	7	6	6	12	19	22	29	25	24	20	22	20	14	20	15	12	17	17	10	16				
	8.0 m	This level was not instrumented for wind speed at this time																											
	4.0 m	7	10	10	9	9	6	9	8	11	10	14	18	14	13	11	13	12	12	7	6	8	9	9	9				
	2.0 m	6	10	7	6	6	4	5	8	11	14	14	18	15	16	12	15	15	13	10	6	10	6	7	12				
	1.0 m	This level was not instrumented for wind speed at this time																											
	0.5 m	This level was not instrumented for wind speed at this time																											

ALBROOK (Forest site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 46.0 m.
(%)

Dir \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N			3.3			3.4			10.4	27.4	37.8	39.9	13.3	26.6	27.5	20.0	13.3	3.3	6.6		6.6	3.3	3.4	
NNE	3.3						3.4			10.4	6.8	10.0	6.6	3.3	3.4	3.3	3.3		3.3					
NE									3.4		6.8	3.3				6.6								
ENE										3.4		3.3												
E																								
ESE																								
SE																								
SSE									3.4			3.3		3.3										
S					3.3																			
SSW		3.3							3.4	3.4														
SW		6.6							3.4						3.4	3.3						3.3		
WSW	3.3	3.3	6.6	3.3	3.3			6.8			3.4		3.3	6.6			6.6		3.3		3.3		3.4	3.3
W	56.4	49.8	49.8	49.8	59.8	61.9	65.4	55.0	20.7		13.8	3.3	16.6	10.0	17.2	26.6	20.0	20.0	16.6	53.1	49.8	59.8	65.4	73.1
WNW	20.0	16.6	23.3	26.6	13.4	20.9	17.3	10.4	10.4	17.2	3.4	3.3	10.0	10.0	3.4	13.3	10.0	20.0	23.3	13.3	23.3	16.6	3.4	6.6
NW	10.0	10.0	6.6	10.0	10.0	3.4	6.8	17.2	17.2	20.8	6.8	20.0	33.2	20.0	13.8	16.6	29.9	33.2	29.9	23.3	13.3	10.0	10.4	13.3
NNW	3.3	3.3	3.3	6.6		3.4			17.2	10.4	20.8	13.3	13.3	16.6	24.2	10.0	16.6	23.3	16.6	6.6			10.4	
CALM	3.3	6.6	6.6	3.3	10.0	6.8	6.8	10.4	10.4	6.8			3.3	3.3	6.8					3.3	3.3	6.6	3.4	3.3

* Note: Due to rounding, percentage totals do not equal 100%.

ALBROOK (Forest site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 26.5 m.
(%)

Dir \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N							3.4		10.4	3.5	17.9	10.0	10.0	16.6	10.4	6.6	10.0	6.6	3.3	3.3			3.4	
NNE									3.4	3.5	3.5	16.6		6.6	6.8	6.6	3.3	6.6	3.3					
NE										21.4	17.9	3.3	10.0	6.6	3.4	10.0	3.3	6.6				3.3		
ENE													3.3		10.4	6.6	3.3		3.3					
E										3.5					3.4		3.3							
ESE											3.5			3.3										
SE												3.3												
SSE														3.3										
S												3.3	3.3	3.3										
SSW										3.5														
SW			3.3						3.4		3.5	3.3				3.3								
WSW								3.4	3.4				3.3		3.4	3.3				3.3	3.3		3.4	
W	10.0	10.0	3.3	6.6	10.0	20.8	17.2	13.8	6.8			3.3	10.0	3.3	6.8		10.0	10.0	6.6	6.6	13.2	10.0	3.4	10.0
WNW	23.3	23.3	26.6	13.3	16.6	10.4	17.2	10.4	6.8	3.5	3.5	6.6	3.3	13.3	3.4	20.0	10.0	3.3	10.0	10.0	13.3	26.6	31.0	23.3
NW	3.3	3.3	6.6	6.6	10.0	6.3	10.4	17.2	13.8	17.9	17.9	16.6	20.0	13.3	13.8	23.3	26.6	13.3	20.0	33.2	23.3	10.0	10.4	6.6
NNW	3.3			3.3			6.8	6.8	3.4	10.8	3.5	6.6	10.0	6.6	10.4	3.3		6.6	13.3	6.6		3.3		6.6
CALM	59.8	63.3	59.8	69.7	63.1	61.8	44.7	48.2	48.2	32.1	28.7	26.6	26.6	23.3	27.5	16.6	29.9	46.6	39.9	36.6	46.6	46.6	48.3	53.1

* Note: Due to rounding, percentage totals do not equal 100%.

IMPRESORA, S. A. 41055

ALBROOK (Forest site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 4.0 m.
(%)

Dir. \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	3.3		3.3		3.3		3.4	6.9	6.9	6.9	3.4	10.0	6.6	3.3	3.4	6.6	13.3	10.0	3.3		10.0	6.6	3.4	
NNE				3.3							6.9	6.6			3.4			6.6	6.6	3.3				
NE												3.3	6.6	10.0	3.4			3.3	3.3	3.3				
ENE									3.4	6.9				6.6			3.3							
E										6.9	3.4		10.0	6.6	6.9	6.6								
ESE												3.3	3.3		6.9									
SE										3.	6.9	6.6	3.3	6.6		6.6								
SSE											3.4				3.4									
S											3.4	10.0	3.3	3.3		3.3		3.3						3.3
SSW				3.3					3.4		10.4	3.3	6.6	6.6	3.4		6.6				3.3			
SW				3.3					3.4		3.4	3.3	3.3	3.3	3.4	3.3	3.3	3.3	3.3			3.3		
WSW									3.4				3.3	3.3			3.3	3.3						3.3
W	3.3	6.6	3.3	3.3	3.3	3.4	3.4			6.9	3.4	3.3	3.3	3.3	3.4	3.3	3.3	10.0	3.3	10.0	3.3		10.4	10.0
WNW	10.0	3.3	6.6	3.3		6.9			3.4	10.4		3.3	3.3			6.6	3.3			6.6	6.6	6.6	6.9	3.3
NW	13.3	10.0	13.3	20.0	26.6	17.2	13.8	6.9	6.9			3.3			3.4	6.6	3.3		10.0	6.6	3.3	16.6	3.4	10.0
NNW	3.3		6.6			10.4		3.4			3.4			10.0							3.3	3.3	13.8	10.0
CALM	66.4	79.7	66.4	63.1	66.4	61.9	79.0	82.4	68.8	58.4	51.6	43.2	46.6	46.6	58.6	56.6	59.8	59.8	69.7	69.7	69.7	63.1	61.9	59.8

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 46.0 m.
(%)

Dir \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	25.8	22.6	25.8	19.4	22.6	19.4	9.7	19.4	38.7	32.2	35.5	29.0	25.8	26.6	38.7	45.2	32.2	29.0	38.7	16.1	16.6	23.3	25.8	16.1
NNE	3.2	3.2				6.4	6.4			22.6	19.4	19.4	16.1	13.3	16.1	9.7	12.9	3.2	3.2	3.2				3.2
NE										12.9	6.4	9.7	12.9		3.2	3.2		3.2						
ENE										3.2														3.2
E																					3.3			
ESE	3.2																							
SE											3.2	3.2												
SSE																								
S													3.2											6.4
SSW			3.2																					
SW		3.2			3.2																			
WSW				3.2		3.2																		
W						3.2		9.7				3.2									3.3	3.3	3.2	
WNW		6.4	3.2	6.4	9.7	3.2	6.4	3.2		3.2			3.2	3.3	3.2	3.2	12.9					3.3	3.2	3.2
NW	19.4	12.9	16.1	32.2	38.7	29.0	45.2	25.8	12.9		12.9		9.7	20.0	9.7	12.9	9.7	22.6	22.6	35.5	26.6	33.2	29.0	29.0
NNW	48.4	51.6	48.4	38.7	25.8	35.5	29.0	41.9	48.4	25.8	22.6	35.5	29.0	36.6	29.0	25.8	32.2	41.9	35.5	45.2	49.8	35.6	38.7	38.7
CALM			3.2				3.2																	

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* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 26.5 m.
(%)

Dir. \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	36.6	29.9	49.8	43.2	29.9	33.2	23.3	26.6	66.4	35.5	25.8	22.6	25.8	49.8	45.2	48.4	46.6	43.2	53.2	59.8	55.0	58.4	49.8	39.9
NNE	13.3	20.0	6.6	3.3	13.3	6.6	6.6	6.6	13.3	19.4	25.8	32.2	29.0	16.6	22.6	19.4	16.6	20.0	20.0	3.3	6.8	3.4	3.3	10.0
NE							10.0	3.3	3.3	29.0	25.8	29.0	19.4	16.6	19.4	12.9	6.6	3.3	6.6	6.6	3.4			3.3
ENE										3.2			6.4		3.2	3.2		3.3						3.3
E	3.3			3.3						3.2		3.2									3.4			3.3
ESE																							3.3	
SE	3.3	3.3				3.3					3.2													3.3
SSE																								
S								3.3				3.2												
SSW							3.3																	
SW	3.3			3.3	3.3				3.3															
WSW																								
W		3.3		3.3		6.6															3.4			
WNW				3.3	3.3			3.3									3.3				3.4	3.4	3.3	
NW	10.0	3.3	16.6	13.3	6.6	10.0	23.3	3.3	3.3	6.4		3.2	9.7	6.6	6.4	6.4	13.3	6.6	3.3	13.3		17.2	10.0	10.0
NNW	29.9	36.6	20.0	26.6	39.9	36.6	29.9	49.8	10.0	3.2	19.4	6.4	9.7	10.0	3.2	9.7	13.3	23.3	16.6	16.6	24.2	17.2	23.3	23.3
CALM		3.3	6.6		3.3	3.3	3.3	3.3															6.6	3.3

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) JANUARY 1967

Relative Frequencies* of Wind Directions by Hour at 4.0 m.
(%)

Dir. \ Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	6.4	19.4	19.4	12.9	6.4	6.4	3.2	12.9	29.0	48.4	45.2	29.0	22.6	36.6	29.0	32.2	45.2	29.0	32.2	16.1	10.0	20.0	16.1	19.4
NNE	3.2		6.4	9.7	12.9		9.7	3.2	12.9	3.2	16.1	22.6	12.9	13.3	3.2	12.9	3.2	6.4	3.2	3.2				9.7
NE		3.2	3.2		6.4		9.7	3.2		16.1	12.9	16.1	19.4	3.3	16.1		6.4				13.3	3.3		6.4
ENE						16.1															3.3			9.7
E				3.2																			3.2	3.2
ESE	3.2	3.2			3.2						3.2													
SE	3.2	3.2																						
SSE																								
S			3.2					3.2				3.2												
SSW						3.2																		
SW		3.2														3.2						3.3	3.2	
WSW		3.2			3.2												3.2							
W	3.2	3.2		3.2	3.2	3.2	3.2	6.4		3.2		3.2					3.2			3.2	3.3	6.6	3.2	
WNW	9.7	9.7	3.2	3.2			16.1	6.4	3.2	3.2			6.4		9.7	3.2	3.2	9.7					3.2	9.7
NW	22.6	22.6	32.2	35.5	29.0	32.2	35.5	35.5	25.8	3.2	12.9	9.7	19.4	23.3	9.7	12.9	12.9	19.4	32.2	38.7	20.0	39.9	32.2	9.7
NNW	41.9	19.4	25.8	25.8	29.0	29.0	12.9	25.8	29.0	22.6	9.7	16.1	19.4	23.3	32.2	35.5	22.6	35.5	32.2	38.7	49.8	26.6	32.2	32.2
CALM	6.4	9.7	6.4	6.4	6.4	9.7	9.7	3.2															6.4	

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* Note: Due to rounding, percentage totals do not equal 100%.

SUMMARY OF NON HOURLY DATA

JANUARY 1967

Summary of Elements with ..-hourly Frequencies of Observation

Site	Element, Units and Exposure	Description	Nu of obs.	Minimum Value	Mean or Total Value	Maximum Value
Albrook (Forest site)	WBGT Index[1] (at 1.0 meters)	Index value	434	63.8	76.6	82.5
		Dry bulb temp.	434	69.2	79.7	91.0
		Wet bulb temp.	434	68.5	75.1	91.0
		Black bulb temp.	434	69.8	80.3	96.8
	Evaporation[3] (in. at 4 levels)	Piche (46.0 m)	31	0.189	15.971*	0.762
		Piche (26.5 m)	31	0.128	11.092*	0.500
		Piche (13.5 m)	31	0.055	5.147*	0.250
		Piche (0.5 m)	31	0.030	3.019*	0.135
	Precipitation from Raingauge Network[2] (in. at 1.0 meters)	Gauge # 1	4	0.01	0.41*	0.33
		Gauge # 2	5	0.01	0.41*	0.34
		Gauge # 3	5	0.01	0.53*	0.41
		Gauge # 4	3	0.01	0.36*	0.32
		Gauge # 5	4	0.01	0.41*	0.33
		Gauge # 6	4	0.01	0.37*	0.30
		Gauge # 7	4	0.01	0.46*	0.35
		Gauge # 8	3	0.01	0.30*	0.25
	Stem Flow[2] (in. at 2.0 meters)	Small tree	2	0.02	0.36*	0.34
		Medium tree	2	0.01	0.49*	0.48
		Large tree	1	0.14	0.14*	0.14
Chiva Chiva (Open site)	WBGT Index (at 1.0 meters)	Index value	434	68.0	79.5	86.9
		Dry bulb temp.	434	68.5	82.8	93.0
		Wet bulb temp.	434	68.0	75.3	93.0
		Black bulb temp.	428	67.9	92.4	112.8
	Evaporation[3] (in. at 0.5 meters)	Piche	24	0.116	8.869*	0.512
		Pan	38	0.054	9.366*	0.531
	Minimum Grass temp[3] (°F at grass tips)	None	30	63.5	67.2	70.0

1 - Hourly observations between 0600 and 1900 hours inclusive

2 - Six hourly observations

3 - Daily observations

*Total Values

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

US Army Tropic Test Center
Fort Clayton, Canal Zone

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

Monthly Microclimatic Summary, January 1967: Environmental Data Base for Regional Studies in the Humid Tropics

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Data Summary, January 1967

5. AUTHOR(S) *(First name, middle initial, last name)*

6. REPORT DATE

March 1968

7a. TOTAL NO. OF PAGES

28

7b. NO. OF REFS

8a. CONTRACT OR GRANT NO.

b. PROJECT NO. 2M025001A724-01

c. USATECOM No. 9-4-0013-01

d. Work Unit: USATTC #001

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

Advanced Research Projects Agency
Army Research Projects Office, OCRD

13. ABSTRACT

This report contains detailed microclimatic data for January 1967 from specific sites in the Panama Canal Zone and vicinity. The data are presented in tabular form, summarized for hourly and or daily observations from surface to 46-meter levels. Elements listed are: temperature, pressure, precipitation, wind speed and direction, relative humidity, and evaporation.

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Climate						
Microclimatology						
Tropic Environment						
Humid Tropics						
Panama Canal Zone Microclimatology						
Data Base						